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EXAMINER

NADAV, ORI

ART UNIT PAPER NUMBER

2811

DATE MAILED: 01/05/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/767,786

Applicant(s)

OHTO ET AL

Examiner

Ori Nadav

Art Unit

2811

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 28 October 2005.
- 2a) ☒ This action is FINAL. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-26 and 83-85 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☒ Claim(s) 83-85 is/are allowed.
- 6) ☒ Claim(s) 1,3-10,14-22 and 26 is/are rejected.
- 7) ☒ Claim(s) 2,11-13 and 23-25 is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☐ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date _____
- 4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____

DETAILED ACTION

Specification

The title of the invention is not descriptive. A new title is required that is clearly indicative of the invention to which the claims are directed.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 1, 3-9, 14-21 and 26 are rejected under 35 U.S.C. 103(a) as being unpatentable over Suzuki et al. (6,514,855) in view of Baklanov et al. (6,593,251), Matsuki et al. (6,559,520) and Shioya et al. (6,852,651).

Suzuki et al. teach in figure 2F and related text a semiconductor device comprising;

a semiconductor substrate 1; and

a multi-layered wiring arrangement provided on said semiconductor substrate, said multi-layered wiring arrangement including at least one insulating layer structure having a metal wiring constitution formed therein,

wherein said insulating layer structure includes a first SiOCH layer 12, a second SiOCH layer 13 formed on said first SiOCH layer, and a silicon dioxide (SiO₂) layer 17

Art Unit: 2811

formed on said second SiOCH layer, and said second SiOCH layer features a carbon (c) density lower than that of said first SiOCH layer (column 5, lines 17-19).

Suzuki et al. do not teach a silicon dioxide (SiO₂) layer formed on said second SiOCH layer, wherein said second SiOCH layer includes a hydrogen (H) density lower than that of said first SiOCH layer, and an oxygen (O) density higher than that of said first SiOCH layer.

Suzuki et al. teach a second SiOCH layer being a porous SiOCH layer.

Baklanov et al. teach an improved porous SiOCH layer having specific concentration of elements.

Matsuki et al. teach a porous SiOCH layer having higher oxygen concentration

Shioya et al. teach in figure 9A a silicon dioxide (SiO₂) layer 35 formed on a SiOCH layer.

It would have been obvious to a person of ordinary skill in the art at the time the invention was made to form a silicon dioxide (SiO₂) layer on said second SiOCH layer, wherein said second SiOCH layer includes a hydrogen (H) density lower than that of said first SiOCH layer, and an oxygen (O) density higher than that of said first SiOCH layer in Suzuki et al.'s device, in order to provide better protection to the device, and in order to improve the characteristics of the porous SiOCH layer, respectively. Note that substitution of materials is not patentable even when the substitution is new and useful.

Safetran Systems Corp. v. Federal Sign & Signal Corp. (DC NIII, 1981) 215 USPQ 979.

Art Unit: 2811

Regarding claims 3-9, 14-21 and 26, Suzuki et al. and Shioya et al. teach an insulating layer structure has a trench pattern formed therein, and said metal wiring constitution comprises a metal wiring pattern buried in said trench pattern, wherein said metal wiring pattern is made of copper (Cu), and a barrier metal layer is formed on wall faces defining said trench pattern to thereby prevent diffusion of copper atoms from said copper wiring pattern into said insulating layer structure,

wherein said barrier metal layer has a single-layered structure, which is formed of one selected from a group consisting of titanium, a titanium compound, tantalum, and a tantalum compound,

wherein said titanium compound is either titanium nitride (TiN) or titanium silicon nitride (TiSiN), and a tantalum compound (Ta) is either tantalum nitride (TaN) or tantalum silicon nitride (TaSiN),

wherein said copper wiring pattern contains at least one aluminum,

wherein said insulating layer structure has at least one hole formed therein, and said metal wiring constitution comprises a metal via-plug buried in said hole, and

wherein a barrier insulating layer on which said first SiOCH₂ layer is formed, and said barrier insulating layer prevents diffusing of copper atoms into said first SiOCH₂ layer when said insulating layer structure is formed on another insulating layer structure having a copper wiring constitution.

Claims 10 and 22 are rejected under 35 U.S.C. 103(a) as being unpatentable over Suzuki et al. (6,514,855), Baklanov et al. (6,593,251), Matsuki et al. (6,559,520)

Art Unit: 2811

and Shioya et al. (6,852,651), as applied to claims 1, 3, 4, 9, 15, 16 and 21 above, and further in view of Chung (6,890,869).

Suzuki et al., Baklanov et al., Matsuki et al. and Shioya et al. teach substantially the entire claimed structure, as applied to claims 1, 3, 4, 9, 15, 16 and 21 above, except said barrier insulating layer has a single-layered structure comprising either a SiNCH layer or a SiCH layer.

Chung teaches a barrier insulating layer has a single-layered structure comprising either a SiNCH layer or a SiCH layer.

It would have been obvious to a person of ordinary skill in the art at the time the invention was made to use a barrier insulating layer having a single-layered structure comprising either a SiNCH layer or a SiCH layer in prior art's device in order to provide better protection for the device.

Allowable Subject Matter

Claims 83-85 are allowed.

Claims 2, 11-13 and 23-25 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

Response to Arguments

Applicant argues that prior art does not teach that the hydrogen density of the second SiOCH layer is lower than that of the first SiOCH layer, and there is no disclosure in the secondary references to modify the teachings of the primary reference to develop a second SiOCH layer with a higher oxygen density than in the first layer.

Suzuki et al. teach the second SiOCH layer being a porous SiOCH layer. Matsuki et al. teach a porous SiOCH layer having higher oxygen concentration, and the advantages thereof. Therefore, it would be obvious for an artisan to form the second SiOCH layer (the porous SiOCH layer) of Suzuki et al. with higher oxygen concentration than that of the first SiOCH layer.

Furthermore, since the porous SiOCH layer of Suzuki et al. now contains more oxygen atoms, then in order to have SiOCH layer it must contain less hydrogen atoms. Also, Baklanov et al. teach that the characteristics of a porous SiOCH layer can be improved by experimenting with specific concentration of the elements thereof. Therefore, it would be obvious for an artisan to form the second SiOCH layer (the porous SiOCH layer) of Suzuki et al. with less hydrogen concentration than that of the first SiOCH layer, in order to obtain an improved porous SiOCH layer.

Applicant argues that Suzuki teaches a hydrocarbon insulating layer, and the examiner did not provide motivation that would lead the person of skill in the art to modify Suzuki to employ the Shioya, et al. teaching of an SiO₂ insulating layer.

Art Unit: 2811

The examiner stated that it would have been obvious to a person of ordinary skill in the art at the time the invention was made to form a silicon dioxide (SiO_2) layer on said second SiOCH layer in Suzuki et al.'s device, in order to provide better protection to the device. Silicon dioxide is known conventional insulating material. Therefore, it would be obvious for an artisan to add a layer of conventional material (silicon dioxide) to Suzuki et al.'s device in order to provide better protection to the device.

Conclusion

THIS ACTION IS MADE FINAL. Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after the end of the **THREE-MONTH** shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than **SIX MONTHS** from the mailing date of this final action.

Art Unit: 2811

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Ori Nadav whose telephone number is 571-272-1660. The examiner can normally be reached between the hours of 7 AM to 4 PM (Eastern Standard Time) Monday through Friday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Eddie Lee can be reached on 571-272-1732. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).



O.N.
1/3/06

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